MARISA PETRUSKY

PhD Candidate at the Nonequilibrium Gas & Plasma Dynamics Laboratory

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EDUCATION

University of Colorado Boulder Boulder, CO
Doctor of Philosophy in Aerospace Engineering Sciences Expected May 2026
Thesis: *Kinetic Modeling of Plasma Electrostatics in Hypersonic Flows*
Advisor: Iain D. Boyd

Master of Science in Aerospace Engineering Sciences, with Certificate in Hypersonics 2023

Stony Brook University Stony Brook, NY
Bachelor of Science in Physics, Summa Cum Laude 2021

RESEARCH INTERESTS

Nonequilibrium Gas Dynamics

Develop and apply theoretical models and numerical methods for simulation of physical phenomena in nonequilibrium gas and plasma flows. Expertise in discrete-velocity methods, Particle-in-Cell, Direct Simulation Monte Carlo (DSMC), and computational fluid dynamics. Applications of interest include hypersonic flows, low temperature plasmas, space debris, atmospheric microphysics.

Scientific Computing

Build scalable software for solving multi-physics computational problems in science and engineering. Expertise in parallel computing, solutions to partial differential equations, Monte Carlo methods, uncertainty quantification.

AWARDS AND HONORS

2025	Graduate School Student Travel Grant, Graduate School, University of Colorado Boulder.
2023	Micheal Springman Aerospace Graduate Fellowship Award, Smead Aerospace Engineering Sciences Department, University of Colorado Boulder.
2021	National Science Foundation Graduate Research Fellowship.
2021	John S. Toll Prize, Department of Physics and Astronomy, Stony Brook University.
2020	Undergraduate Recognition Award for Outstanding Achievement in Community Service, Stony Brook University.
2020	Sigma Pi Sigma, American honor society for physics and astronomy.
2019	Summer Research Award, Department of Physics and Astronomy, Stony Brook University.
2019	Researcher of the Year, Women in Science and Engineering Honors College, Stony Brook University.

JOURNAL PUBLICATIONS

5. **M. Petrusky**, I.D. Boyd. Characterization of Plasma Diffusion in Hypersonic Flows. *In preparation.*

4. **M. Petrusky**, I.D. Boyd. Discrete-Velocity Simulation of a One-Dimensional Hypersonic Stagnation Streamline. 2026. *In revision.*

3. D. Adihikari, et al. [The CREX Collaboration, including **M. Petrusky**].† Precision Determination of the Neutral Weak Form Factor of ^{48}Ca. *Physical Review Letters*, 129(4), 2022. DOI: 10.1103/PhysRevLett.129.042501

2. D. Adihikari, et al. [The PREX and CREX Collaborations, including **M. Petrusky**].† New Measurements of the Beam-Normal Single Spin Asymmetry in Elastic Electron Scattering over a Range of Spin-0 Nuclei. *Physical Review Letters*, 128(14), 2022. DOI: 10.1103/PhysRevLett.128.142501

†Indicates alphabetical ordering.

1. D. Adihikari, et al. [The PREX Collaboration, including **M. Petrusky**].† Accurate Determination of the Neutron Skin Thickness of ^{208}Pb through Parity-Violation in Electron Scattering. *Physical Review Letters*, 126(17), 2021. DOI: 10.1103/PhysRevLett.126.172502

PEER-REVIEWED CONFERENCE PROCEEDINGS

2. **M. Petrusky**, I.D. Boyd. Evaluation of the Ambipolar Diffusion Approximation using an Eulerian Boltzmann-Poisson-BGK Solver. *To appear in Rarefied Gas Dynamics: Proceedings of the 33rd International Symposium*, 2026.

1. I. Petrushina, R. Zgadzaj, **M. Petrusky**, et al. Characterization of the Fields Inside the CO_2-Laser-Driven Wakefield Accelerators using Relativistic Electron Beams. *2022 IEEE Advanced Accelerator Concepts Workshop (AAC)*, 1–6, 2022. DOI: 10.1109/AAC55212.2022.10822933

PAPERS PRESENTED AT PROFESSIONAL MEETINGS

1. **M. Petrusky**, I.D. Boyd. A Novel Stagnation Streamline Model for Discrete-Velocity Simulation of Hypersonic Flows. *AIAA AVIATION FORUM AND ASCEND 2025*, AIAA 2025-3475, 2025. DOI: 10.2514/6.2025-3475. *Featured article at the AIAA Showcase on Kudos.*

ABSTRACTS PRESENTED AT PROFESSIONAL MEETINGS

Not including papers and proceedings listed above.

8. **M. Petrusky**, D. Martinez, K.S. Kulick. Incorporation of Dialogic Learning in STEM Classrooms. 67$^{\text{th}}$ Annual Meeting of the APS Division of Plasma Physics, Long Beach, CA, November 17-21, 2025.

7. **M. Petrusky**, I.D. Boyd. Impact of Poisson Equation Boundary Conditions in Modeling Partially Ionized Hypersonic Flows. 67$^{\text{th}}$ Annual Meeting of the APS Division of Plasma Physics, Long Beach, CA, November 17-21, 2025.

6. **M. Petrusky**, I.D. Boyd. Guidelines for Use of the Ambipolar Diffusion Approximation in Rarefied Hypersonic Flows. DSMC 2025 Conference, Santa Fe, NM, September 28-October 1, 2025.

5. **M. Petrusky**, W.R. Chan, I.D. Boyd. Assessing the Ambipolar Diffusion Approximation for Rarefied Hypersonic Plasma Shock Layers. 65$^{\text{th}}$ Annual Meeting of the APS Division of Plasma Physics, Denver, CO, October 30-November 3, 2023.

4. **M. Petrusky**, I.D. Boyd. Direct Kinetic Modeling of the Plasma Generated in a Rarefied Hypersonic Shock Layer. 2023 International Conference on Plasma Science, Santa Fe, NM, May 21-25, 2023.

3. **M. Petrusky**. An Analysis of Academic Culture and its Impact on Young Professionals. Symposium on Advancing Equity in Higher Education on Long Island, online, April 9, 2021.

2. **M. Petrusky**, T. Ye, C. Ghosh, A. Deshpande, K. Kumar. Determining the Position Dependency of Cherenkov Radiation in Quartz. APS Conference for Undergraduate Women in Physics, Philadelphia, PA, January 19, 2020.

1. **M. Petrusky**, T. Ye, C. Ghosh, A. Deshpande, K. Kumar. Determining the Angular Dependency of Cherenkov Radiation in Quartz. Scientista Symposium Poster Competition, Boston, MA, March 30, 2019.

RESEARCH EXPERIENCE

Nonequilibrium Gas and Plasma Dynamics Laboratory — Boulder, CO
Graduate Research Assistant — 2021–Present

- Primary maintainer of in-house discrete-velocity solver, which solves Boltzmann-BGK-Poisson equations for discretized probability density function. Refactored code, implemented 1D3V dimensionality and Parallel Kinetic Perpendicular Moment method, added multiple new physical processes.
- Characterize electrostatic field formation in hypersonic flows in rarefied atmospheres.
- Establish general guidelines for use of ambipolar diffusion and free diffusion approximations and quantify impact on quantities of interest for hypersonic flows.

RESEARCH EXPERIENCE, CONTINUED

Analytical Mechanics Associates Moffett Field, CA
Aerothermodynamics Intern at NASA Ames Summer 2024

- Extended Data Parallel Line Relaxation Code's (DPLR) 1D subsonic shock space marcher to simulate supersonic region of shock tube.
- Developed computational framework for including viscous effects in DPLR's space marcher.

Plasma Accelerator Group Stony Brook, NY
Undergraduate Research Assistant 2020–2021

- Wrote open-source 3D3V Quasi-static Electron Propagation (QuEP) Monte Carlo particle solver.
- Developed proof of concept for experimental diagnostics of electron beam through laser-induced plasma wakefields using QuEP.

Lead (Pb-208) Radius Experiment (PREX) Collaboration Newport News, VA
Undergraduate Research Assistant 2017–2019

- Conducted studies of particle position and angular dependencies in Cherenkov detectors.
- Wrote Gas Electron Multiplier detector alignment software for PREX experiment.

TEACHING

Teaching Areas

- Aerospace Engineering: Thermodynamics, Hypersonic Aerothermodynamics, Fluid Mechanics, Compressible Flows, Molecular Dynamics.
- Physical Sciences: Electromagnetic Theory, Statistical Mechanics, Plasma Physics.
- Applied Mathematics: Numerical Analysis, Partial Differential Equations, Computer and Programming Fundamentals.

Teaching Experience

Spring 2025	ASEN 5151: Fundamentals of Gas Dynamics. Sole graduate teaching facilitator, 50 students.
Summer 2023	ARSC 3700: McNair Scholars Seminar: Research Design. Graduate part time instructor (Instructor of record), re-designed course, 10 students.
Summer 2022	ARSC 3700: McNair Scholars Seminar: Research Design. Co-graduate teaching facilitator, 16 students.

Pedagogical Development

Spring 2025	Dialogic Pedagogy of Practice Program, CU Dialogues Program and the Center for Teaching and Learning, Boulder, CO.
Fall 2024	DEI-Informed Dialogic Pedagogy Micro-Credential, CU Dialogues Program and the Center for Teaching and Learning, Boulder, CO. Badge issued via Credly.
Spring 2019	JRN 365: Talking Science, School of Communication and Journalism and the Alan Alda Center for Communicating Science, Stony Brook, NY.

PROFESSIONAL SERVICE

Professional society memberships

- American Institute of Aeronautics & Astronautics

2025	Workshop Volunteer, Girls Exploring Science, Technology, Engineering, and Math.

- American Physical Society

2021–Present	Member, Division of Plasma Physics Pride.
2022	Guest Physicist, Physicist-to-Go Program.

PROFESSIONAL SERVICE, CONTINUED

Symposia

2025–Present	Organizing Committee, International Symposium on Rarefied Gas Dynamics Next Generation

Service at University of Colorado Boulder

2023–Present	Fall Admissions Master of Science Application Review Committee, Aerospace Engineering Sciences Department.
Fall 2024	Volunteer, First-Year Aerospace Boot Camp Seminar Series.
2021–2024	Graduate Student Mentor, McNair Scholars Program.
2021–2023	Inclusive Culture Committee, Aerospace Engineering Sciences Department.
2021–2023	Diversity, Equity, and Inclusion Chair, Aerospace Graduate Student Government.
Fall 2022	Lead, Aerospace Engineering Sciences PhD Applicant Mentoring Pilot Program.
Spring 2022	Critical Needs Faculty Search Committee, Aerospace Engineering Sciences Department.

Service at Stony Brook University

2018–2021	Vice President, Stony Brook Society of Physics Students chapter.
2018–2020	Peer Mentor, Women in Science and Engineering Honors College.

SEMINARS AND TALKS

7. Plasma Physics from A-Z. Student Day Tutorial Talk, 67$^{\text{th}}$ Annual Meeting of the APS Division of Plasma Physics. November 16, 2025.
6. Applying to Graduate School: Engineering Panel. 2025 Physics and Astronomy Congress, October 31-November 1, 2025. *Invited panelist.*
5. Applying to Graduate School in Aerospace Engineering. Rarefied Gas Dynamics Next Geneneration Talks, online, August 18, 2025.
4. Evaluation of Charged Species Diffusion in Hypersonic Flows. Rarefied Gas Dynamics Next Geneneration Talks, online, June 18, 2025.
3. Charting Your Course In Undergrad. Honors Alumni Speaker Series, Stony Brook University, online, March 5, 2025.
2. Modeling Plasma Dynamics during Hypersonic Entry. 2024 Future Leaders in Aerospace Symposium, Stanford, CA, May 15-17, 2024.
1. The Art of Flexible Science Communication. Aerospace Engineering Sciences Fluids-Structures-Materials Seminar Series, Boulder, CO, September 20, 2023.

SELECT WORKSHOPS

5. Conference for Graduate Women and Gender Minorities in Physics. Washington, D.C., September 25-26, 2025.
4. University of Colorado – Rocky Mountain Advanced Computing Consortium AI Workshop, Boulder, CO, August 5-6, 2025.
3. Plasma Communication and Assessment Tools for Public Engagement Workshop, Morgantown, WV, June 1, 2025.
2. Future Leaders in Aerospace Symposium, Stanford, CA, May 15-17, 2024.
1. US ITER Research Program Research Needs Workshop, online, February-April 2022.

References available upon request.